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AUTHOR Bragg, Sadie
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ABSTRACT

This document reports the findings from a National Science Foundation (NSF) workshop on the integral role of two-year colleges in the science and mathematics preparation of prospective teachers. Representatives from four-year colleges and universities, school systems, professional societies, and government agencies met with two-year college faculty, administrators, and students to explore issues important to the development of teachers who were well-prepared in science, mathematics, and technology and who were well-qualified to teach. Participants developed recommendations for future activities and projects designed to improve the quality of future teachers in the United States. (CCM)

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ED 427 968

Investing in Tomorrow's Teachers

The Integral Role of Two-Year Colleges in the Science and Mathematics Preparation of Prospective Teachers

A REPORT FROM A NATIONAL SCIENCE FOUNDATION WORKSHOP

Division of Undergraduate Education
Directorate for Education and Human Resources
National Science Foundation
December 1998

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Investing in Tomorrow's Teachers

The Integral Role of Two-Year Colleges in the Science and Mathematics Preparation of Prospective Teachers

A REPORT FROM A NATIONAL SCIENCE FOUNDATION WORKSHOP

Sadie Bragg
Chair
March 12 – 14, 1998

Division of Undergraduate Education
Directorate for Education and Human Resources
National Science Foundation
December 1998

FOREWORD

This document reports findings from the workshop on the integral role of two-year colleges in the science and mathematics preparation of prospective teachers. This was a joint effort of the National Science Foundation and the Virginia Urban Corridor Collaborative for Excellence in Teacher Preparation. The workshop was developed with leadership from the Division of Undergraduate Education and significant support from other divisions of the Directorate for Education and Human Resources. The American Association of Community Colleges and Phi Theta Kappa, the national honor society for two-year colleges, ensured that representatives from all groups who are stakeholders in the preparation of teachers were afforded opportunities to address issues.

On March 12 – 14, 1998, two-year college faculty, administrators, and students met with representatives from four-year colleges and universities, school systems, professional societies, and government agencies to explore issues important to the development of teachers well-prepared in science, mathematics, and technology and well-qualified to teach. During the three days, participants developed recommendations for future activities and projects designed to improve the quality of the U. S. future teachers. The role of helping to prepare future teachers was recognized as consistent with the community-based and student-centered missions articulated by two-year colleges. Two -year colleges can play an important role in helping prepare teachers of mathematics, science, and technology.

The opinions expressed in this report are those of the workshop participants and do not necessarily represent NSF policy. The recommendations are under review at NSF.

Luther S. Williams

Luther S. Williams
Assistant Director
Education and Human Resources
National Science Foundation

LETTER OF TRANSMITTAL

September 3, 1998

Dr. Luther S. Williams
Assistant Director
Directorate for Education and Human Resources
National Science Foundation
4201 Wilson Boulevard
Arlington, VA 22230

Dear Dr. Williams:

On behalf of the steering committee, I am pleased to transmit to you the report of the National Science Foundation (NSF) conference, ***The Integral Role of the Two-Year College in the Science and Mathematics Preparation of Prospective Teachers***. This conference was convened by the Division of Undergraduate Education of NSF and held March 12 - 14, 1998.

The conference focused on strategies to increase the awareness of two- and four-year college mathematics and science faculty and administrators, national leaders in education, and funding agencies to the key role that community colleges are providing in the mathematical and scientific preparation of teachers. Over 100 participants represented faculty and administrators from science, mathematics and education departments in two-and-four year colleges, disciplinary professional societies, other organizations and federal agencies, and current preK-12 teachers and pre- service teachers from two-year colleges.

With the assistance of the steering committee, the coordinating committee and NSF staff, participants received assignments prior to the conference designed to stimulate their thinking in six critical areas. Each of the following six areas was addressed by an interdisciplinary working group:

- recruitment of prospective teachers;
- strengthening undergraduate courses;
- pre-teaching experiences;
- in-service activities;
- liaisons between two-year colleges and four-year institutions; and
- liaisons with business and industry, professional societies and others.

Participants also worked in discipline-based groups to develop specific recommendations about how two-year colleges can move individually and collectively to develop programs to meet the national need for high-quality teacher preparation.

Members of the steering and coordinating committees and the chairs and recorders of the six working groups have reviewed this report. We now submit it to NSF in the spirit of cooperation, collaboration and mutual optimism for the future of the science, mathematics, and technology preparation of prospective elementary and secondary teachers. We encourage NSF, in concert with two-and four-year colleges, discipline-based organizations, and other national organizations and federal agencies, to take a leadership role in implementing the recommendations in the report. It is commendable that NSF has begun to actively engage two-year colleges through undergraduate programs such as the NSF Collaboratives for Excellence in Teacher Preparation; Course, Curriculum, and Laboratory Improvement; and Advanced Technological Education. We look forward to a more specific focus on teacher preparation in two-year colleges.

On behalf of all participants of the conference, we wish to extend to you, and Dr. Norman Fortenberry, Dr. Robert Watson, Dr. Elizabeth Teles, Dr. Jack Hehn and Dr. Terry Woodin of the Division of Undergraduate Education, our deepest appreciation for your support of this endeavor. The education community applauds your continued commitment to undergraduate education in the science, mathematics, and technology preparation of future elementary and secondary teachers and your recognition of the integral role of two-year colleges.

Sincerely,

Sadie C. Bragg

Sadie C. Bragg
Chair, Steering Committee
Borough of Manhattan Community College
The City University of New York

Executive Summary

The workshop ***Investing in Tomorrow's Teachers: The Integral Role of the Two-Year College in the Science and Mathematics Preparation of Prospective Teachers*** was held in Washington, DC on March 12 – 14, 1998. Eleven exemplary two-year college programs chosen in a national competition were highlighted at the conference. Over 100 individuals participated, including faculty and administrators from two-year colleges already engaged in exemplary activities in teacher preparation; faculty and administrators from science, mathematics, and education departments in two- and four-year colleges who have responsibility for the various components of teacher preparation; representatives from national disciplinary professional societies and organizations specifically devoted to the preparation of teachers; and current preK-12 teachers and pre-service teachers from two-year colleges. Participants considered the role of two year colleges in the preparation of teachers and then developed a set of recommended actions.

Current Role

It has become increasingly apparent that the resources of the nation's community colleges must be utilized fully if the need for a teaching force well prepared in science, mathematics, engineering, and technology (SMET) is to be met. Generally, neither two-year colleges, nor the four-year institutions where teachers complete their preparation, nor the schools that hire teachers fully recognize the essential role of two-year colleges in teacher preparation. In many ways, the preparation of teachers is a hidden mission of two-year colleges. Many future elementary and middle school teachers are taking most, if not all, of their college-level science and mathematics courses at two-year colleges. Equally important is the potential for each of the nation's two-year college to provide active leadership in recruiting the next generation of elementary and secondary school teachers. Two-year colleges, with their orientation towards teaching and their strategic locations, are in a pivotal position to recruit and help prepare the next generation of science and mathematics teachers as well as give students preparing to teach in the elementary grades a strong grounding in science, mathematics, and technology.

Recommended Actions

Recommendations for action were developed in the following areas:

- recruitment of prospective teachers;
- strengthening undergraduate science, mathematics, engineering, and technology courses;
- pre-teaching experiences;
- in-service activities;
- liaisons between two-year colleges and four-year institutions; and
- connections with business and industry, professional societies, and other organizations.

The recommendations, detailed in this report and summarized below, address actions two-year colleges can undertake by themselves and in partnership with four year colleges or professional societies.

Two-year colleges should:

- Recruit and attract the best students to the teaching of science, mathematics, engineering, and technology.
- Actively involve SMET faculty and administrators in institution-wide recruitment of prospective teachers through such activities as visiting area high schools in coordination with guidance counselors or participating in on-campus visitation days for prospective students.

Teaching is the essential profession, the one that makes all other professions possible. Without good teachers, the highest standards in the world will not ensure that our children are prepared to be the nation's future scientists, or productive citizens ... More than ever before in our history, education is the fault line between those who will prosper in the new economy and those who will be left behind.

William Jefferson Clinton
Presidential State of the Union Address, 1997

A large percentage of prospective teachers begin their education in two-year colleges. These institutions, with their clear commitment to teaching and with so many prospective teachers as students, must be more significant partners in the system of teacher preparation.

Shaping the Future (NSF 96-139)

- Include teacher preparation efforts into the colleges' mission and strategic plans.
- Provide meaningful and frequent professional development in SMET both within and across disciplines for full-time and adjunct faculty.
- Offer continuing education programs for teachers as a regular component of workforce training initiatives to meet the needs of regional employers.

Two-year colleges should collaborate with four-year colleges and universities and school systems to:

- Coordinate student advising for prospective teachers between two-year and four-year institutions concerning the transfer of courses, financial support, and program requirements.
- Eliminate the barriers of course transferability by articulating transfer agreements between two-year colleges and four-year institutions that are mutually established through open communication concerning specific course content and expectations.
- Design and implement high-quality science, mathematics, and technology curricula.
- Engage potential teachers in preK-12 tutoring, mentoring, and enrichment programs in SMET fields.
- Cooperate with local school districts and institutions such as science museums and mathematics and science centers to provide SMET pre-teaching experiences for two-year college students.
- Engage potential teachers as teaching assistants in inquiry-based SMET classroom and laboratory settings and in testing and evaluation.
- Engage professionals in the community from business and industry to provide students and faculty in two-year colleges with information and perspective about how science, mathematics, and technology are applicable to teaching and other career tracks.
- Promote joint professional education activities involving student groups between two-year colleges and four-year institutions.
- Work with local school systems and state policy officials to establish stronger teacher certification standards.

Professional societies should work with two-year colleges to:

- Highlight the roles of two-year colleges in the science and mathematics preparation of future teachers.
- Seek students from two-year colleges for membership and welcome as members two-year college students who wish to pursue careers as teachers.

Implementation of the recommendations of this report requires all groups involved in the preparation of teachers to take a more proactive role than in the past. Two-year colleges must plan and work cooperatively with four-year colleges and universities, school systems, professional societies, business and industry, state, local, and national government agencies, and with each other. No one group can do it alone. All must cooperate. Participants summarized by noting that with support from the National Science Foundation and others who share this vision, two-year colleges can help our nation produce a teaching workforce highly qualified in science, mathematics, and technology.

INVESTING IN TOMORROW'S TEACHERS

Investing in Tomorrow's Teachers: The Integral Role of the Two-Year College in the Science and Mathematics Preparation of Prospective Teachers

INTRODUCTION

In order to better understand and increase the awareness of the role of two-year colleges, a major resource in teacher preparation, the Division of Undergraduate Education of the National Science Foundation (NSF) convened a national conference ***The Integral Role of the Two-Year College in the Science and Mathematics Preparation of Prospective Teachers*** in Washington, DC on March 12 – 14, 1998. Eleven exemplary two-year college programs chosen in a national competition were highlighted at the conference. In introducing them, the NSF director, Dr. Neal Lane, remarked:

> *The exemplary activities being showcased here accomplish the best of all possible educational objectives. They equip students with skills that enable them to step directly into today's technological workforce. They also provide the broader opportunities to learn mathematics and science and to practice habits of mind and problem solving techniques that will serve students well if they are called to teaching or other careers.*

At the conference, science and mathematics faculty, presidents, and other administrators from these eleven colleges joined other national leaders to assess successful two-year college teacher preparation approaches underway and to develop specific recommendations concerning how two-year colleges can better help to meet the national need for well-prepared teachers of science, mathematics, and technology. This role of helping to prepare future teachers was recognized as consistent with the community-based and student-centered missions articulated by two-year colleges. Yet, the role of two-year colleges in teacher preparation has often gone unrecognized. In many ways, the preparation of teachers is a hidden mission of two-year colleges.

Over 100 individuals participated, including:

- faculty and administrators from eleven two-year colleges who are among those already engaged in exemplary activities in teacher preparation;
- faculty and administrators from science, mathematics, and education departments in two- and four-year colleges who have responsibility for various components of teacher preparation;
- representatives from national disciplinary professional societies and from organizations specifically devoted to the preparation of teachers; and

- current preK-12 teachers and pre-service teachers from two-year colleges.

Participants developed detailed recommendations concerning the role of two-year colleges in the following areas:

- recruitment of prospective teachers;
- strengthening undergraduate science, mathematics, engineering, and technology courses;
- pre-teaching experiences;
- in-service activities;
- liaisons between two-year colleges and four-year institutions; and
- connections with business and industry, professional societies, and other organizations.

Subsequent sections of this report lay out the conference's specific recommendations articulating how two-year colleges can move individually and collectively to ensure that all involved in the science, mathematics, and technology preparation of prospective teachers recognize the crucial role of two-year colleges and that two-year colleges with their partners develop programs that meet the national need for well-qualified teachers.

BACKGROUND

The science, mathematics, and technology preparation of the next generation of teachers is critical to the social and economic future of the nation. Demographics indicate that the nation's colleges and universities must begin to produce many more teachers than they are currently producing. There is an even greater need for teachers willing and prepared to teach in the inner cities, in remote rural areas, and in schools with large minority populations and for mathematics and science teachers in all regions. The performance of United States students on international tests suggests that the consequences of putting into classrooms large numbers of middle and high school science and mathematics teachers who have neither majored nor minored in mathematical or scientific disciplines and of hiring elementary school teachers with inadequate preparation in science and mathematics are not acceptable.

Historically, teacher preparation has been considered the province of a small number of four-year colleges and universities. While two-year colleges have always played an unrecognized role in teacher preparation, with support from NSF and their communities, two-year colleges are beginning to take more active leadership roles in undergraduate science, mathematics, engineering, and technology (SMET) instruction including the science and mathematics courses taken by future teachers. Currently, two-year colleges enroll nearly half of all United States undergraduates and over one-third of all students taking science, mathematics, and engineering and technology (SMET) courses. In increasing numbers, two-year colleges are recruiting more future teachers, providing them with stronger mathematical and scientific preparation, and utilizing their college resources to meet the challenges facing elementary and secondary education. According to Luther Williams, NSF's Assistant Director for Education and Human Resources,

> *The resources of the nation's community colleges must be utilized fully if the need for a teaching force well prepared in science, mathematics, engineering, and technology is to be met.*

THE NEED

The number of new teachers that will be needed within the next decade is daunting. The U.S. Department of Education predicts that 40% of current public school teachers will retire or leave the profession by the 2003-4 school year. At the same time, school enrollments are rising dramatically. In the next ten years, America will need to hire two million new teachers to replace the generation of teachers about to retire and to keep up with rising enrollments. The NSF report ***Shaping the Future: New Expectations for Undergraduate Education in Science, Mathematics, Engineering, and Technology*** (NSF 96-139), as well as many other studies, have made a persuasive case that America's future teachers require stronger backgrounds in science, mathematics, and technology. The number of teachers essential for a strong school system becomes even greater as additional states legislate limits on class sizes.

In many parts of the country, a large percentage of elementary and middle school science and mathematics classrooms are currently being staffed by teachers with little or no college-level training in science or mathematics. In his address ***The State of Mathematics Education: Building a Strong Foundation for the 21st Century*** on January 9, 1998 at the annual joint meeting of the American Mathematical Society and the Mathematical Association of America, U.S. Secretary of Education Richard Riley lamented:

> *Presently, 28 percent of high school math teachers do not have a major or minor in mathematics. The average K-8 teacher takes three or fewer mathematics or mathematics education courses in college. Furthermore, fewer than one-half of 8th grade mathematics teachers have ever taken a course in the teaching of mathematics at this level. Equally distressing, the teacher qualifications are even lower in low income and minority schools. We must do better.*

Secretary Riley also noted that 18 percent of high school science teachers neither majored nor minored in science. In the physical sciences, where 12th grade student performance lags the most in international assessments, almost half of American students are taught by teachers without a major or minor in that field.

The recently released reports of the ***Third International Mathematics and Science Study*** (TIMSS) reveal that U.S. students are less successful than their counterparts in other nations as they progress through the various grade levels. Although students in elementary grades at least match international averages in the TIMSS, the performance of high school seniors is almost last in both mathematics and science. The reasons for this poor level of performance are complicated, but significant improvement would be encouraged by a teaching corps that is well prepared in both content and pedagogy of science, mathematics and technology.

Many new teachers must be encouraged, willing, and prepared to teach in the inner cities, in remote rural areas, and in schools with large minority populations. In July of 1997, President Clinton also called attention to the need for well-trained college graduates to enter the teaching profession and, in particular, to the critical need for teachers who can serve as role models for inner-city students.

ROLE OF TWO-YEAR COLLEGES

According to data gathered by the American Association of Community Colleges (AACC), the more than 1,100 two-year colleges across the country currently enroll about 45% of all U.S. undergraduates, with more than 5 million students in credit classes (*1997 AACC Facts*, 1997). In the fall of 1992, two-year institutions accounted for over 40% of all undergraduate science, mathematics, engineering, and technology courses and 34% of all undergraduate SMET course enrollments (*Shaping the Future*). While precise data do not exist, it is estimated that more than 40% of teachers completed some of their science and mathematics course work at two-year colleges. Indeed, many future elementary and middle school teachers are taking most, if not all, of their college-level science and mathematics courses at two-year colleges.

Generally, neither two-year colleges, nor the four-year institutions where teachers complete their preparation, nor the schools that hire them fully recognize the essential role of two-year colleges in teacher preparation. The fact that two-year colleges are already heavily engaged in the mathematical and scientific preparation of teachers is one reason to recognize more prominently this priority of two-year schools. However, an equally important reason is the opportunity of each two-year college in the nation to make important contributions to recruiting and training the next generation of elementary and secondary school teachers. Because excellent instruction is the primary focus at two-year colleges, their faculty members are well positioned to provide leadership in the quality of instruction in mathematics and science. Furthermore, two-year colleges are often located in regions directly serving rural and urban communities where new teachers will be needed most. Thus, two-year colleges, with their orientation towards teaching and their strategic locations, are in a pivotal position to recruit and help prepare the next generation of science and mathematics teachers as well as give students preparing to teach in the elementary grades a strong grounding in science, mathematics, and technology.

The way the community college works here in Texas and across America, in my view, is a model of the way America ought to work. ... You think about it. This place ... is open to all. Nobody gets turned away because they're too old or too young or because of the color of their skin or because of their gender or anything else. ... It very much focuses on results, not rhetoric. ... [and] they're always about change, not about the status quo. ... [Finally, community colleges are] much more about partnership than politics. The whole thing ... works when people are working together to build a community.

William Jefferson Clinton
San Jacinto Community College, Houston, Texas,
September 26, 1997

RECRUITMENT OF PROSPECTIVE TEACHERS

Two-year colleges have a major role to play in expanding the pool of prospective teachers of mathematics and science. They should be encouraged to tie the recruitment of teachers directly to the institution's strategic plan.

David Pierce
President
American Association of
Community Colleges

Two-year colleges play a critical role in attracting people with a high potential for becoming excellent teachers. These institutions are strategically positioned in urban and rural regions, enroll a large proportion of the nation's minority college students, and welcome returning adults. Given this large and diverse student body, the nation benefits to the extent that the most talented in this large student population consider teaching as a career option.

In an effort to expand the pool of prospective teachers and to improve the academic preparation of teachers in SMET, two-year colleges must identify, attract, nurture, and guide individuals from within their student population who have the potential to become excellent teachers. Recruitment and encouragement of prospective future teachers at two-year colleges should be undertaken as a comprehensive, coordinated effort, tied directly to the institution's long-term strategic plan. State policies and structures should be reevaluated to ensure that they do not hinder efforts to recruit new teachers. Most importantly, SMET college faculty and advisors must heighten respect for the teaching profession as a worthy career for outstanding students.

Recognizing that they have a major role to play in the recruitment of students into careers in teaching, two-year colleges should:

- Recruit and attract the best students to the teaching of science, mathematics, engineering, and technology.

- Actively involve SMET faculty and administrators in institution-wide recruitment of prospective teachers through such activities as visiting area high schools in coordination with guidance counselors or participating in on-campus visitation days for prospective students.

Five years ago when one of my students said that they had an interest in teaching, all I could say was "That's nice. Teaching is a great profession." Now as a result of my involvement in the Virginia Urban Corridor Collaborative for Excellence in Teacher Preparation supported by NSF, there are opportunities to offer students. These include the teaching apprenticeship program at J. Sargeant Reynolds Community College, visitations to science and mathematics classrooms, and joint registration in the Virginia Commonwealth teacher preparation programs. Faculty awareness has increased. Funds are available to support student experiences. Science and mathematics classes have been redesigned to increase student interest in inquiry-based teaching and learning. It's great.

Donna Jovanovich,
Mathematics Faculty, J.
Sargeant Reynolds
Community College,
Richmond, Virginia

- Work collaboratively with school systems and four-year institutions to develop recruitment and retention programs.

- Create networks among business and industry and community-based and religious organizations for effective recruitment into teaching.

- Join with professional associations to initiate public campaigns on community, state, and national levels to emphasize the need, importance, and rewards of teaching as a profession.

- Recruit potential teachers from various segments of the population, including minorities and underrepresented groups, mid-career changers, paraprofessionals, and other nontraditional students.

- Provide prospective students with complete information regarding pathways to SMET teacher certification.

- Provide students with research-oriented science experiences that encourage them to consider science or mathematics as an academic major and teaching as a profession.

- Advocate for financial incentives such as scholarships, loans, or loan forgiveness on the federal and state levels for students who plan to teach.

- Encourage businesses and foundations to develop and/or expand financial incentives for students who plan to teach.

- Offer programs with strong SMET components to prepare paraprofessionals for full certification.

- Include teacher recruitment efforts in the colleges' mission and strategic plans.

STRENGTHENING UNDERGRADUATE SCIENCE, MATHEMATICS, ENGINEERING, AND TECHNOLOGY COURSES

Faculty involvement has been high from the beginning and continues to be a key factor . The emphasis is on the learner and the learning environment. Expectations for student success are high. Though initially designed for preservice teachers, we found that all students benefit from these courses. Our faculty are energized.

Ronald A. Williams
Acting President
Community College of Philadelphia

Two-year colleges have a responsibility to ensure that prospective teachers complete science, mathematics, and technology courses of the highest quality. Programs of study for future teachers should include multidisciplinary approaches and be informed by discipline based research in teaching and learning as well as research in education and cognitive science. Because teachers usually base their own teaching approaches on the way that they have been taught, it is vital that college courses emphasize inquiry activities and experiential discovery.

Excellence in instruction is the primary focus at two-year colleges. Thus two-year college science, mathematics, engineering, and technology faculty are positioned to provide national leadership in the quality and nature of instruction. Many future preK-12 teachers choose teaching as a career after completing the first two years of college. Structuring all two-year college mathematics and science instruction to reflect active, participatory, discovery-oriented approaches provides those students who become teachers a sound foundation in both the content and methods of science and mathematics and enhances the entry-level mathematics, science, and technology experiences for all students.

Two-year college SMET faculty should:

- Ensure that SMET courses and experiences become more centered in the student and the processes of the SMET disciplines.

- Ensure that all students have frequent access to inquiry-based experiences in and outside of class.

As a two-year college faculty member in the discipline of physics, I am committed to delivering high quality instruction for prospective teachers.

Mary Beth Monroe
Southwest Texas Junior College

Mathematics faculty will provide learning activities, including projects and apprenticeships, that promote independent thinking and require sustained effort and time so students will have the confidence to access and use needed mathematics and other technical information independently, to form conjectures from an array of specific examples, and to draw conclusions from general principles.

Standard P-5
Crossroads in Mathematics Standards for Introductory College Mathematics Before Calculus
American Mathematical Association of Two-Year Colleges

- Collaborate with preK-12 teachers and four-year faculty to design and implement high-quality science, mathematics, and technology curricula.

- Integrate results of cognitive research and standards-based curriculum development into SMET instruction.

Two-year colleges SMET departments should:

- Hire and support full-time and adjunct faculties who incorporate standards-based instruction.

- Provide meaningful and frequent professional development in science, mathematics, engineering, and technology both within and across disciplines for full-time and adjunct faculty.

- Encourage and support full-time and adjunct faculty's participation in professional organizations and development activities.

- Provide reassigned time for faculty to engage in classroom research, curriculum development, and dissemination.

Federal, state, and private funding agencies should support:

- Development of standards-based SMET curricula at the introductory college level.

- Collaboration among preK-12 teachers, two-year college faculty, and four-year college and university faculty to implement curricula.

- Local and regional initiatives that enhance communication and collaboration among SMET and other disciplines.

- Professional development activities for faculty who teach in SMET fields.

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PRE-TEACHING EXPERIENCES

This conference underscored for us the critical role the College of San Mateo and other community colleges play in equipping future teachers with the knowledge, skill, and ability they will need to educate tomorrow's students and prepare them for the demands of the new century.

Peter J. Landsberger
President
College of San Mateo

Experiences that introduce students to the excitement of helping others to learn and acquaint them with the rewards of teaching are critical to the recruitment and development of the workforce of future teachers. Two-year colleges, in collaboration with others, should actively seek to engage students and faculty in authentic pre-teaching experiences that encourage and support prospective teachers. In order to provide this engagement, each college must assess its current policies and practices, and a full commitment must be made through initiatives at local, state, and national levels.

Two-year colleges should:

- Engage potential teachers in preK-12 tutoring, mentoring, and enrichment programs in SMET fields.

- Cooperate with local school districts and institutions such as science museums and mathematics and science centers to provide pre-teaching experiences.

- Engage potential teachers as teaching assistants in inquiry-based SMET classroom and laboratory settings and in testing and evaluation.

- Support faculty efforts to initiate programs of SMET pre-teaching experiences for prospective teachers.

- Work with four-year colleges and universities to provide structured opportunities for prospective teachers to visit preK-12 classrooms and to observe a variety of science and mathematics teaching strategies, use of technology, assessment, and individual work with students.

I've always wanted to be a teacher. It was my childhood dream; now I know where I belong. In a class where the teacher cares, and you know they care, you push yourself just a little bit harder. Community college teachers know your name; they know your strength; they know your weaknesses. I will try to have the same experience with each student I teach..The Collaborative's goals to improve the quality of math and science instruction is appropriate. I like the hands-on approach. When you have something in your hand, you can visualize it better. My goal is to turn science into something that kids can touch.

Bernice Collins
Preservice Teacher
J. Sargeant Reynolds
Community College

The Virginia Urban Corridor Collaborative for Excellence in Teacher Preparation awarded Bernice one of the two National Science Foundation Teaching Scholars scholarships given to a two-year college student planning on teaching K-8 mathematics or science. Bernice is now attending J. Sargeant Reynolds Community College; however, because of the Collaborative, she knows she has already been accepted to Virginia Commonwealth University for next year.

- Provide prospective teachers with support structures (future teacher associations, faculty mentoring, and advising programs) that provide career exploration and articulate transfer paths to professional certification.

- Acknowledge pre-teaching activities through formal recognition, student record annotation, and other incentives.

- Provide financial support and incentives such as internships to encourage students to engage in pre-teaching experiences.

- Work with industry and business to enable future teachers to learn about the role of science, mathematics, and technology in the workplace.

- Work with four-year colleges and universities and the schools to provide early field experiences for students.

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In-Service Activities

We must realize that the teaching modeled in our classrooms influences the learning environment in a great many primary and secondary schools throughout our nation. New inquiry-based active learning approaches show great promise for improving the teaching of science and mathematics.

George Boggs
President
Palomar Community College

From the college faculty point of view, in-service and pre-service activities are closely linked. Two-year colleges, with their presence in many communities, are a natural resource for delivering professional development for preK-12 teachers. Two-year college faculty are well versed in working with adult learners and are well positioned to take leadership roles in providing and supporting these in-service activities. A by-product of participation by two-year college faculty in in-service activities is an increased appreciation of the value of standards-based instruction that may be reflected in improvements to their own college courses. In particular, participation in in-service teacher training may generate faculty involvement and interest in the recruitment and preparation of prospective teachers at two-year colleges.

Two-year colleges should:

- View the provision and support of strong SMET in-service programs for current preK-12 teachers as an area of high priority.

- Offer continuing education programs for teachers as a regular component of workforce training initiatives to meet the needs of school districts.

- Work collaboratively with other providers of professional development opportunities to offer a rich overall continuing education program in all SMET areas.

- Recognize that, in many rural areas, the two-year college must serve as the primary provider of continuing education opportunities and, in conjunction with area school systems and four-year institutions, develop a comprehensive in-service SMET program.

Tulsa Community College is excited about its role in preparing teachers of mathematics and science as well as providing on-going staff development in these disciplines for current elementary and secondary teachers. My dream and vision is that our college will provide the encouragement and support for other community colleges to become models of excellence.

Dean VanTrease
President
Tulsa Community College

♦ Design SMET professional development activities that foster utilization of research-based and standards-based pedagogy.

Professional associations should:

♦ Seek adequate funding for mutually beneficial partnerships among two-year colleges, preK-12 schools and other contributors to SMET teacher professional development.

♦ Create SMET programs that simultaneously address the continuing professional development needs of faculty from preK-12 schools, two-year colleges, and four-year institutions.

Two-year college administrators should:

♦ Support professional development opportunities in SMET such as team teaching, teacher exchanges, sabbatical assignments, and peer observation among faculty from preK-12 schools, two-year colleges, and four-year institutions.

♦ Provide incentives for the professional growth and development of all faculty who participate in the science, mathematics, and technology preparation of prospective preK-12 teachers.

♦ Establish expectations that all faculty who participate in the science, mathematics, and technology preparation of prospective preK-12 teachers be involved in ongoing professional growth and development activities.

LIAISONS BETWEEN TWO-YEAR COLLEGES AND FOUR-YEAR INSTITUTIONS

I am proud of our mathematics and science faculty for their contributions to the Delaware initiative for reform in teacher education. Through collaborative efforts with other institutions, changes were made which enable Delaware Technical and Community College to make significant progress toward meeting national standards in mathematics and science reform. This progress is critical and an essential ingredient in preparing future teachers to meet the challenge of success in the classroom.

Orlando J. George
President
Delaware Technical and
Community College

Traditionally the preparation of teachers of science and mathematics has been viewed as the exclusive purview of four-year institutions. Because a large percentage of prospective preK-12 teachers begin their education in two-year colleges, two- and four-year colleges must work collaboratively in the science, mathematics, and technology preparation of future teachers. Not only do students at two-year colleges transfer to four-year institutions to complete their education training and certification, but faculty at two-year colleges are themselves the product of the four-year institutions. Although two- and four-year colleges have different overall missions, in the area of science and mathematics teacher preparation, they must share a common goal to prepare preK-12 teachers who are well trained, qualified, and motivated. To reduce barriers that hinder smooth transition of prospective teachers, colleges and universities need to improve transfer programs, partnerships, and professional development opportunities.

Two- and four-year colleges and universities should:

- Work together to develop two-year college SMET programs that provide seamless transition to teacher preparation programs at four-year institutions.

- Coordinate student advising for prospective teachers between two-year and four-year institutions concerning the transfer of courses, financial support, and program requirements.

- Eliminate the barriers of course transferability by articulating transfer agreements between two-year colleges and four-year institutions that are mutually established through open communication concerning specific course content and expectations.

Here at The City College/City University of New York, the faculty in the School of Education have worked closely with the faculty at Borough of Manhattan Community College on curricular issues in the science and mathematics preparation of future teachers for the city. Collaborations between two- and four-year colleges are paramount in the preparation of prospective teachers.

Sam H. Frank
Dean,
School of Education
City College of New York

- Reduce the cultural barriers and misconceptions between two-year colleges and four-year institutions by encouraging the exchange of faculty and facilitating SMET topical workshops.

- Support transition of students through the personal involvement of SMET faculty at two-year and four-year institutions.

- Work collaboratively to ensure that two-year colleges and four-year institutions are both represented as preK-16 SMET educational policy is formulated.

- Increase the number of partnerships between two-year colleges and four-year institutions focusing on joint SMET program development and dissemination.

- Promote joint professional education activities involving student groups between two-year colleges and four-year institutions.

- Work with local school systems and state policy officials to establish stronger teacher certification standards.

- Develop collaboratively a teaching track for M.S. and Ph.D. SMET students whose career goal is to teach at two-year colleges.

- Increase sustainable joint SMET professional development opportunities (co-teaching, teacher exchange, and others) by preK-12 institutions and two- and four-year colleges for full-time and adjunct faculty.

- Encourage partnerships that jointly address major public issues facing SMET educational policy and practice (e.g., adoption of standards, approaches to teaching practices and content, mandatory program requirements, expectations of students' skills and knowledge, appropriate role of technology in SMET teacher preparation, and roles of teaching assistants and adjunct faculty in preK-12 SMET teacher preparation.)

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CONNECTIONS WITH BUSINESS, INDUSTRY, AND PROFESSIONAL SOCIETIES

The issues on creation of alliances and sustained cooperation among partners included ... participation by employers in the educational process (e.g., providing content expertise and adjunct faculty, making special facilities available to students and faculty, and supporting faculty and work experiences at employer work sites.)

Gaining the Competitive Edge
NSF 94-32

Two-year colleges contribute significantly to the economic health and vitality of the cities or regions in which they are located. As a result, groups or organizations that have a stake in the success of students at two-year colleges can have great influence on two-year college programs. These include SMET professional societies at local, regional, state, and national levels as well as business and industry, other professional societies, parents, informal education agencies, museums, legislative bodies, and accrediting agencies. Awareness by these communities of the contributions of two-year colleges in the science, mathematics, and technology preparation of prospective teachers is vital. Two-year colleges should convene forums on their campuses with representatives from state legislatures, members of the preK-12 and higher education communities, and business and industry to discuss issues of SMET teacher preparation.

Business and industry should:

- Provide internships and other opportunities to enable future teachers and teacher educators to learn about the role of science, mathematics, and technology in the workplace.

- Communicate clearly to future teachers' expectations about the desired characteristics of potential employees.

- Provide scholarships for students and support for equipping laboratories and enhancing technology.

- Engage professionals in the community to provide students and faculty in two-year colleges with information and perspective about how science, mathematics, and technology are applicable to teaching and other career tracks.

As the mathematical professional societies work together on the Mathematics Education of Teachers Project to improve the preparation of tomorrow's teachers, the active participation of the two-year college community is essential because of the critical role that two-year college faculty play in the education of many of these teachers.

Ronald Rosier
Administrative Officer
Conference Board of the
Mathematical Sciences

SMET Professional Societies should:

- Highlight the roles of two-year colleges in the science and mathematics preparation of future teachers.

- Seek students from two-year colleges for membership and welcome as members students who wish to pursue careers as teachers.

- Promote opportunities for full participation of prospective SMET teachers at professional meetings.

- Establish student chapters on two-year college campuses.

- Recruit faculty from two-year colleges to join and assume leadership roles.

- Publicize efforts by two-year colleges in teacher preparation through various media and to a variety of targeted audiences.

A CALL FOR ACTION

The science, mathematics, and technology preparation of the next generation of elementary and secondary schoolteachers is a critical national concern. Every two-year college in the country has the opportunity and responsibility to address this challenge. This leadership conference calls upon the nation's two-year colleges to make teacher preparation in SMET a major priority. This requires assessment by each college of its priority and current practices and full commitment on the part of all sectors of the two-year college community—presidents, trustees, faculty, and students—and collaborations with all pertinent education and community sectors.

Participants in this workshop developed a comprehensive set of detailed recommendations concerning the role of two-year colleges:

Recruitment

- **Two-year colleges should actively recruit prospective teachers from the areas that the two-year colleges serve.** Two-year colleges are uniquely placed to participate in recruiting the numbers of teachers that are needed nationally and, in particular, to recruit future teachers who can best understand the needs of the communities that the colleges serve.

Leadership

- **Two-year colleges should demonstrate leadership in strengthening the undergraduate mathematics, science, and technology courses taken by prospective teachers at both two- and four-year colleges.** Two-year college faculty specialize in the development and teaching of freshman and sophomore courses and are therefore in a pivotal position to provide national leadership in this area.

Pre-Teaching Experiences

- **Two-year colleges should provide rich and varied pre-teaching experiences in SMET for their students.** Students beginning their undergraduate work need pre-teaching opportunities including mentoring and tutoring preK-12 students and serving as instructor aides in a variety of elementary, secondary and college settings. The activities can help students confirm their interest in teaching mathematics and science by involvement in pre-teaching experiences that foster creativity, curiosity, and inquiry.

In-Service Experiences

- **Two-year colleges should provide in-service SMET courses and experiences for current teachers**. Providing continuing education in science, mathematics, and technology is particularly important for two-year colleges located in large urban areas with specific needs. In many rural areas, the two-year college must serve as the primary provider of comprehensive in-service programs, developed in conjunction with local school systems.

Conference participants also recognized that activities by two-year colleges related to teacher preparation must be undertaken in conjunction with four-year institutions and others involved in the science, mathematics, and technology preparation of prospective teachers.

Coordination

- **Two-year college efforts in the preparation of teachers must take place in close coordination with four-year institutions**. Careful attention must be paid to articulation agreements and clear policies must be developed concerning transfer, joint advising, and joint-registration.

Collaboration

- **Two-year colleges and four-year institutions must collaborate to strengthen and align science, mathematics, and technology courses for prospective teachers**, to establish student transfer agreements, and to provide mutual support for one another's role in teacher education.

Partnerships

- **Two-year colleges must become full partners in all discussions about the SMET preparation of future teachers**. Fully engaging two-year colleges in the preparation of teachers will require liaisons with business and industry, professional societies, state legislatures, and statewide and national policy boards.

Faculty Cooperation

- **Faculty in two- and four-year colleges and universities should establish cooperative ventures affecting teacher preparation activities.** A dialogue between faculty should be established among two-year colleges, four-year college and university science and mathematics departments, and colleges of education.

It is the expectation of conference participants that the above recommendations will lead to action. Conference participants, professional societies, and other national leaders designed to highlight the role of the two-year college in teacher preparation are already accomplishing much; however, further efforts must also take place nationally.

Information

- **The need for more information was highlighted.** Conference participants recognized as a high priority the need for more detailed information concerning the role of two-year colleges in the SMET preparation of teachers. In particular, data should be collected on a national level to determine what percentage of new teachers studied mathematics and science education at two-year colleges and the extent of the studies.

Scholarship

- **Effective partnerships are needed involving many groups.** Two-year colleges should work with the American Association of Colleges for Teacher Education (AACTE), the Holmes Partnership, and others, to facilitate understanding and recognition of the role of two-year colleges in teacher preparation.

Support

- **External support is needed to initiate change.** Financial support from federal, state, corporate, and foundation sources is necessary for full implementation of these recommendations.

ACTIONS TAKEN AS A RESULT OF WORKSHOP

- Two-year college presidents, deans, and other administrators returned from the conference and committed their institutions and systems to an increased focus on the preparation of SMET teachers.

- The American Association of Community Colleges (AACC) is sending letters to all two-year colleges announcing the recommendations of this conference. The communication includes testimonials from presidents at the colleges recognized at this conference, indicating the impact that teacher preparation initiatives have had on their institutions.

- The American Mathematical Association of Two-Year Colleges (AMATYC), through the Teacher Preparation Subcommittee of its Program/Curriculum Issues Committee, is referring the recommendations to the AMATYC membership for action. AMATYC has included in its next conference program sessions featuring the teacher preparation activities of the colleges recognized at this conference. Recent AMATYC newsletter articles have addressed the conference activities.

- The American Association of Physics Teachers, through its Two-Year College in the Twenty-First Century (TYC21) program, has formed a national alliance of fifteen regional networks. A special "Bridges" session at the 1998 summer TYC21 conference addressed bridging activities concerning the training of prospective precollege teachers and showcased many of the exemplary activities.

- The Virginia Mathematics and Science Coalition in conjunction with the National Association of Statewide Science and Mathematics Coalitions (NASSMC) has agreed to devote a special issue of *The Journal of Mathematics and Science: Collaborative Explorations*, to the conference and reports of the work of the eleven exemplary activities.

- The League for Innovation in the Community College has invited members of the Conference Steering Committee to submit a Leadership Abstract on the role of two-year colleges in preK-12 teacher preparation.

- The Mathematical Association of America (MAA) has highlighted the work of the conference and the role of two-year colleges through a feature article in FOCUS: "Enlisting Two-Year Colleges in Educating Mathematics Educators."

- Recruiting New Teachers, Inc. is conducting a study of community college programs that both encourage and enable prospective teachers to complete the baccalaureate degree and link to teacher preparation.

Actions in Progress: Activities Highlighted at Conference

In March 1998 at the conference ***The Integral Role of the Two-Year College in the Science and Mathematics Preparation of Prospective Teachers***, NSF's Division of Undergraduate Education in the Directorate for Education and Human Resources recognized eleven two-year colleges for their exemplary activities in the area of teacher preparation. These colleges were selected by the Steering Committee from among thirty-seven nominations from across the nation. Characteristics of these projects include: active recruitment of prospective teachers; the offering of pre-teaching experiences for prospective teachers; introductory science and mathematics courses strong in content and pedagogy; and many and varied liaisons with local colleges, universities, and school systems. For more information about these projects, see the October 1998 special issue of *The Journal of Mathematics and Science: Collaborative Explorations, Volume 1, Number 2*. Copies can be obtained by writing: Journal of Mathematics and Science Collaborative Explorations, Virginia Mathematics and Science Coalition, Richmond, Virginia 23284-2014.

Austin Community College, Austin, Texas

Learning to Understand: The Mathematical Preparation of Prospective Teachers
Mary Hannigan and Vera Preston

Austin Community College faculty have collaborated with university faculty to develop a two-course sequence in mathematics content that prepares prospective elementary teachers to teach mathematics with a deep understanding of concepts. As a result of taking these courses, students accept responsibility for their own learning, have increased self-confidence, and show enthusiasm for mathematics. Components of these courses include:

- a safe environment in which students become independent learners;
- written communication as an integral part of the course; and
- students who increase their conceptual understanding.

Borough of Manhattan Community College
City University of New York, New York

The Integral Role of Borough of Manhattan Community College in the Mathematics Preparation of Prospective Teachers
June Gaston and Barbara Ann Lawrence

At Borough of Manhattan Community College, high quality teacher preparation is promoted through mathematics coursework built upon recommendations of the National Council of Teachers of Mathematics and the American Mathematical Association of Two-Year Colleges (AMATYC). Over 1,000 students are enrolled in the Early Childhood Education Program, with approximately 300 new students annually selecting this area of concentration. Features of teacher preparation activities at the Borough of Manhattan Community College include:

- enriching pre-teaching experiences;
- collaborating with four-year institutions in teacher preparation efforts;
- teaching students how to use technology in future courses; and
- attracting minorities into teacher preparation for New York City.

College of San Mateo,
San Mateo, California

The College of San Mateo and the Bay Area Collaborative for Excellence in Teacher Preparation
Carlene Tonini

Through the MASTEP project (Mathematics and Science Teacher Education Program), the College of San Mateo has joined with nearby universities, other community colleges, selected preK-12 schools, and a number of informal educational institutions and local industries to improve teacher preparation. The College of San Mateo plays a major role in identifying and supporting future teachers and providing these students with courses that are models of effective teaching. Teacher preparation activities at the College of San Mateo include:

- recruitment of future mathematics and science teachers through an active future teacher club;
- tutoring, mentoring and advising though the activities of an integrated science center; and
- significant involvement of science and mathematics faculty in curriculum reform.

Community College of Philadelphia
Philadelphia, Pennsylvania

Educating Teachers for a Changing World
Kerri L. Armstrong and Karl Liljedahl

Through a partnership with Temple University and the Philadelphia School System supported by an NSF Collaborative for Excellence in Teacher Preparation grant, the Community College of Philadelphia has created a model for preK-12 teacher education which integrates new inquiry-intensive and technology-based pedagogy with mathematics and science core content courses. Features of newly created and implemented science and mathematics courses are:

- emphasis on a learning paradigm rather than a teaching paradigm;
- a focus on the learner and the learning environment;
- high expectations for student success; and
- individual and collaborative inquiry in an environment which expects and demands critical thinking.

Delaware Technical & Community College
Wilmington, Delaware

Preservice Teacher Education: Alive and Well at Two-Year Colleges
Valerie Bergeron and Ruth Collins

Delaware Technical & Community College is one of the three state-supported institutions of higher education in Delaware. As a result of collaboration among the three institutions and with NSF support, preservice teacher education at all three institutions has been transformed. The words "collaboration," "creativity," "communication," and "change" only begin to describe the activities which have occurred.

For example, extensive projects were introduced into eight courses in biology, chemistry, and physical science. The preservice mathematics courses at Delaware Technical & Community College have become "hands-on" and "minds-on." Student response to the work at all schools has been consistently positive.

Grand Rapids Community College
Grand Rapids, Michigan

Accepting the Challenges: The Emerging Role of Grand Rapids Community College in the Preparation of New Teachers
Jim Chesla and Joseph Hesse

In 1992, Grand Rapids Community College was one of six community colleges invited to participate in an NSF initiative to improve science and mathematics teaching within the state of Michigan. In response to this challenge, Grand Rapids Community College has:

- designed a new course in Physical Science for future teachers;
- created the Grand Rapids Community College Teacher Education Pathway and the Grand Rapids Community College Teacher Education Center; and
- formed a local alliance with Grand Rapids Public Schools and Grand Valley State University for the purpose of recruiting and supporting minorities in mathematics and science teaching.

Green River Community College
Auburn, Washington

Teachers of Tomorrow Program
Steve Kinholt and Marvin Nelson

About five years ago, Green River Community College began offering tutoring services by students interested in becoming teachers to a few local elementary schools. Current planning includes efforts with local school systems and universities to provide a seamless transition through the students' educational experience. Green River Community College is contributing to systemic change in the preparation of future science and mathematics teachers in the Northwest. The program includes:

- two courses: Mathematics for Elementary Teachers and Introduction to Education;
- a club for students wishing to enter the teaching profession; and
- elementary and secondary and peer tutoring programs as an integral part of the students' experience.

Henry Ford Community College
Dearborn, Michigan

Pre-Education Programs: A Comprehensive Project at Henry Ford Community College
Larry Smyrski and Deborah Zopf

Henry Ford Community College has initiated a comprehensive project to develop a structured teacher education program. The redesigned Mathematics for Elementary Teachers course reflects the State of Michigan Frameworks for Mathematics Content (K-8) and the NCTM Standards. As a result of these reforms, Henry Ford Community College has experienced a dramatic increase in pre-education majors from 354 students in 1994 to 697 in 1997. The project has five central components:

- creation of a pre-elementary education program;
- development of pre-secondary and pre-special education programs;
- creation of courses specific to the programs;
- redesign of Educational Psychology and Mathematics for Elementary Teachers courses; and
- institution of articulated transfer agreements as a result of collaboration with neighboring universities.

J. Sargeant Reynolds Community College
Richmond, Virginia

Collaborative Efforts to Enhance and Strengthen Teacher Training in Mathematics and Science
Donna Jovanovich and Gwen Turbeville

With NSF support, J. Sargeant Reynolds Community College is engaged in active collaborations with Virginia Commonwealth University and other area two- and four-year colleges and universities and local school districts. Benefits of these collaborations extend to Reynolds students, to its pre-service teachers, to local preK-12 teachers, as well as to faculty by opening dialogue and enabling faculty to explore and fine tune new teaching techniques. Newly developed courses and institutes model best practices in teaching, assessment techniques, and use of appropriate technology, and promote a standards-based approach considering the Virginia Standards of Learning and the NCTM and AMATYC Standards. The fruits of these collaborations include:

- a team-taught statistical thinking course;
- a contemporary mathematics course for liberal arts students and students who are prospective teachers;
- an interdisciplinary museum-based science course based on a student-centered, investigative approach to learning science; and
- Eisenhower institutes for in-service teachers on graphing calculator-enhanced teaching and geometry.

Tulsa Community College
Tulsa, Oklahoma

Parateacher Training Program and ***The Integral Role of Tulsa Community College in the Mathematics and Science Preparation of Prospective Teachers***
Carla Goble and Carla Thompson

Since 1987, Tulsa Community College has hosted many events, activities, and programs aimed at the recruitment and preparation of preservice teachers. Partial support for such efforts has come from participation in the Oklahoma Teacher Collaborative (O-TEC), funded by the National Science Foundation. The Parateacher Program in particular is an innovative pathway for underserved and non-traditional populations to enter science and mathematics teaching. Upon completion of training, parateachers are prepared to become contributing members of the teaching team led by a Bachelor's or Master's level classroom teacher. Components of these programs include:

- recruitment and emphasis on underrepresented groups;
- parateacher associate degree/certification program;
- preservice and inservice preparation;
- state and federal grants for summer teacher institutes; and
- workshops, seminars, and other activities.

William Rainey Harper College
Palatine, Illinois

Classroom Teachers' Use of Research to Effect Change in Pre-Service Elementary Teachers
Mercedes McGowen and Nancy Vrooman

William Rainey Harper College has incorporated activities that utilize current mathematics education research articles and videos into the preservice content course, with these outcomes:

- broadening and deepening preservice teachers' understanding of the complexities of teaching and learning;
- encouraging students to develop reflective practices; and
- exposing students to the scholarship of teaching.

The use of the articles and videos brings benefits to the preservice elementary teachers by providing experiences that:

- effect changes in their attitudes about mathematics;
- challenge their pre-conceived ideas about what they themselves and elementary students are capable of learning;
- engage the preservice teachers in professional practices that inform a variety of perspectives about teaching; and
- enable the students to re-examine their own mathematics learning.

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Participants

Investing in Tomorrow's Teachers: The Integral Role of the Two Year College in the Science and Mathematics Preparation of Prospective Teachers

March 12 - 14, 1998
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Kerri Armstrong
Department of Biology
Community College of Philadelphia
1700 Spring Garden Street
Philadelphia, PA 19130
215-751-8559

Kathleen Bavelas
Department of Mathematics
Manchester Community-Technical College
Mathematics Department
60 Bidwell Rd, MS 29
Manchester, CT 06045
860-647-6185

Peggy Blackwell
Professor and Dean Emeritus
College of Education
University of New Mexico
Albuquerque, NM 87131
505-277-3883

Richelle "Rikki" Blair
Department of Mathematics
Lakeland Community College
7700 Clocktower Drive
Kirtland, OH 44094
440-953-7341

*** Spencer Benson**
Department of Biology
University of Maryland
Department of Microbiology
College Park, MD 20742
301-405-5478

Valerie Bergeron
Department of Chemistry
Delaware Technical & Community College
333 Shipley Street
Wilmington, DE 19801
302-657-5170

*** George Boggs**
President
Palomar College
1140 West Mission College
San Marcos, CA 92069-1487
760-744-5359

**** Sadie Bragg**
Vice President of Academic Affairs
Borough of Manhattan Community College
199 Chambers Street
New York, NY 10007
212-346-8820

S.A. "Bud" Burnette
President
J. Sargeant Reynolds Community College
P.O. Box 85622
Richmond, VA 23285-5622
804-371-3200

*** Rodger Bybee**
Executive Director
Center for Science, Mathematics and Engineering Education
National Research Council
2101 Constitution Ave, NW
HA450
Washington, DC 20418
202-334-2353

Richard "Dick" Calkins
President
Grand Rapids Community College
143 Bostwick Ave, NE
Grand Rapids, MI 49503
616-771-3902

Jon A. Celesia
Department of Physics
College of San Mateo
1700 W. Hillsdale Blvd.
San Mateo, CA 94402
650-574-6624

Jim Chesla
Department of Mathematics
Grand Rapids Community College
143 Bostwick, NE
Grand Rapids, MI 49503
616-771-4273

Ruth Collins
Department of Mathematics
Delaware Technical & Community College
333 Shipley Street, Rm 329
Wilmington, DE 19801
302-571-5335

Nancy Devino
National Research Council
Center for Science, Mathematics and Engineering Education HA450
2101 Constitution Ave, NW
Washington, DC 20418
202-334-1548

Marvin Druger
American Association for the Advancement of Science
Chair, Department of Science Teaching
Syracuse University
108 College Place
Syracuse, NY 13244
315-443-3820

 # Jason Edington
Phi Theta Kappa
Saddleback College
28000 Marguerite Parkway
Mission Viejo, CA 92692
714-582-4500

Diane U. Eisenberg
Project Coordinator
Improving Science and Technology at Community Colleges
Phi Theta Kappa Honor Society
Eisenberg Associates
8872 Woodland Drive
Silver Spring, MD 20910
301-562-9260

+ Reuben Farley
Department of Mathematical Sciences
Director, Virginia Collaborative for Excellence in Preparation of Teachers
Virginia Commonwealth University
P.O. Box 842014
Richmond, VA 23284-2014
804-828-1301 x 121

Joan Ferrini-Mundy
Director Mathematical Science Education Board
Center for Science, Mathematics and Engineering Education
National Research Council
2101 Constitution Ave, NW
Washington, DC 20418
202-334-3294

Elizabeth Fideler
Vice President, Policy and Research
Recruiting New Teachers Inc.
385 Concord Ave, Suite 103
Belmont, MA 02178
617-489-6000

Susan Forman
Department of Mathematics
Bronx Community College
West 181st Street and University Avenue
Bronx, NY 10453
718 289-5372

Larry Flick
Association for the Education of Teachers in Science
Department of Science and Mathematics Education
Oregon State University
Weniger 263
Corvallis, OR 97331-6508
541-737-3664

+ Sherman Frye
Department of Physics
Northern Virginia Community College, Annandale Campus
8333 Little River Turnpike
Annandale, VA 22003
703-323-3878

Sol Garfunkel
Executive Director
COMAP
57 Bedford St. Suite 210
Lexington, MA 02173
781-862-7878 x 21

June Gaston
Department of Mathematics
Borough of Manhattan Community College
199 Chambers Street
New York, NY 10007
212-346-8541

Jim Gates
Executive Director Emeritus
National Council of Teachers of Mathematics
Mathematical Sciences Education Board
2101 Constitution Avenue, NW
HA 450
Washington, DC 20418
202-334-3294

Patsy Ann Giese
Teacher Education Council of State Colleges and Universities
Department of Education
Slippery Rock University
McKay Education Building
Slippery Rock, PA 16057
724-738-2317

Carla Goble
Coordinator Child Development Academic Program
Tulsa Community College
7505 West 41st Street
Tulsa, OK 74107
918-595-8199

Beth Gross
Recruiting New Teachers Inc.
385 Concord Ave, Suite 103
Belmont, MA 02178
617-489-6000

Mary Hannigan
Department of Mathematics
Austin Community College
1212 Rio Grande
Austin, TX 78701
512-223-3294

+ Elsie Harris
Department of Mathematics
Tidewater Community College, Virginia Beach Campus
1700 College Crescent
Virginia Beach, VA 23456
757-321-7177

+ Bill Haver
Department of Mathematical Sciences
Virginia Commonwealth University
P.O. Box 842014
Richmond, VA 23284-2014
804-828-1301 x 123

Warren Hein
Associate Executive Officer
American Association of Physics Teachers
One Physics Ellipse
College Park, MD 20740
301-207-3323

Joe Hesse
Department of Chemistry
Grand Rapids Community College
143 Bostwick NE
Grand Rapids, MI 49503
616-771-4259

Fred Johnson
President
National Science Teachers Association
Assistant Superintendent for Instructional Services
Shelby County Schools
160 South Hollywood
Memphis, TN 28112
901-321-2527

Donna Jovanovich
Department of Mathematics
J. Sargeant Reynolds Community College
P.O. Box 85622
Richmond, VA 23285-5622
804-371-3481

*** Judy Kasabian**
Department of Mathematics
El Camino College
16007 Crenshaw Blvd
Torrance, CA 90506-0001
310-660-3218

Steve Kinholt
Department of Mathematics
Green River Community College
12401 SE 320th Street
Auburn, WA 98092
253-833-9111 x 4354

Larry D. Kirkpatrick
Department of Physics
Montana State University
MSU Bozeman
Physics EP 203
Bozeman, MT 59717
406-994-6182

*** Jay Labov**
Principal Program Officer
Division on Postsecondary Policy and Practice
Center for Science, Mathematics and Engineering Education
National Research Council
2101 Constitution Ave, HA450
Washington, DC 20418
202-334-1458

Carole LaCampagne
Office of Educational Research and Improvement
U.S. Department of Education
555 New Jersey Ave, NW
Washington, DC 20208
202-219-2064

Peter Landsberger
President
College of San Mateo
1700 West Hillsdale Blvd.
San Mateo, CA 94402

Barbara Ann Lawrence
Professor of Mathematics
Borough of Manhattan Community College
199 Chambers Street
New York, NY 10007
212-346-8530

Frances H. Leach
Dean of Instruction
Delaware Technical & Community College
333 Shipley Street
Wilmington, DE 19801
302-571-5376

Karl Lilijdahl
Department of Biology
Community College of Philadelphia
1700 Spring Garden Street
Philadelphia, PA 19130
215-751-8989

Linda Lloyd
Chair of Elementary Education Department
Ricks College
Smith Building, #294C
Rexburg, ID 83460
208-356-1357

Andrew A. Mazzara
President
Henry Ford Community College
5101 Evergreen Road
Dearborn, MI 48128
313-845-9650

Mercedes McGowen
Department of Mathematics
William Rainey Harper College
1200 W. Algonquin Road
Palatine, IL 60067
847-925-6526

+ Alan McLeod
Division Head, Teacher Education
School of Education
Virginia Commonwealth University
P.O. Box 842020
Richmond, VA 23284-2020
804-828-1305

Gerald "Jerry" Meyerhoeffer
President
College of Southern Idaho
315 Falls Avenue
P.O. Box 1238
Twin Falls, ID 83303
208-733-9554 x 2200

Cindy Miles
Director, Information Technology Initiative
League for Innovation in the Community College
26522 La Alameda,
Suite 370
Mission Viejo, CA 92691
714-367-2884 x 105

Lawrence Miller
Vice President/Campus Director
Delaware Technical & Community College
333 Shipley Street
Wilmington, DE 19801
302-573-5470

 # Sarah Miller
Phi Theta Kappa
Sparks State Technical College
P.O. Drawer 580
Eufaula, AL 36072-0580
334-687-3543

 # Lori Mitchell
Phi Theta Kappa
Southwestern Community College
1501 West Townline
Creston, IA 50801
515-782-7081

*** Mary Beth Monroe**
Department of Physics
Southwest Texas Junior College
2401 Garner Field Road
Uvalde, TX 78801
830-591-7224

+ Roland Moore
Division Chair - Arts and Science Division
J. Sargeant Reynolds Community College DTC
P.O. Box 85622
Richmond, VA 23285-5622
804-786-7374

Terri Nally
Head, Department of Higher Education
American Chemical Society
1155 Sixteenth Street, NW
Washington, DC 20036
202-872-4587

++ Deborah Neely-Fisher
Department of Biology
J. Sargeant Reynolds
Community College DTC
Arts and Science Division
P.O. Box 85622
Richmond, VA 23285-5622
804-786-1879

Marvin Nelson
Department of Physics
Green River Community College
12401 SE 320th Street
Auburn, WA 98092
253-833-9111 x 4351

Arnold Oliver
Chancellor
Virginia Community College
System
101 N. 14th Street
James Monroe Building, 15th fl
Richmond, VA 23219
804-225-2118

Ardash Ozsogomonyan
Dean- Mathematics and Science
Division
College of San Mateo
1700 W. Hillsdale Blvd.
San Mateo, CA 94402
650-574-6268

Wayne Packwood
Math Chair- Stephen F. Austin
High School
1715 West Cesar Chavez
Austin, TX 78703
512-414-2505

*** Jim Palmer**
Department of Educational
Administration and Foundation
Illinois State University
323 DeGarmo Hall
Normal, IL 61790-5900
309-438-2041

Jim Paolini
Science Education Program
San Jose State University
One Washington Square
San Jose, CA 95192
408-924-4835

Antonio Perez
President
Borough of Manhattan Community
College
199 Chambers Street
New York, NY 10007
212-346-8800

*** David Pierce**
President and CEO
American Association of
Community Colleges
One Dupont Circle, NW
Suite 410
Washington, DC 20036-1176
202-728-0200 x 238

Robert Pope
Department of Biology
Miami-Dade Community College
Kendall Campus
Miami, FL 33176
305-237-2429

Vera Preston
Department of Mathematics
Austin Community College
2001 Delvin Lane
Austin, TX 78728-6830
512-252-8990

Monica Ramirez
Chair, Science Department
Aims Community College
Math/Natural and Applied Science
Division
P.O. Box 69
Greeley, CO 80632
970-330-8008 x 6310

*** Rod Risley**
Executive Director
Phi Theta Kappa International
Honor Society
1625 Eastover Drive
Jackson, MS 39211
601-957-2241

Sandra Robinson
The Holmes Partnership
Dean - College of Education
University of Central Florida
P.O. Box 161992
Orlando, FL 32816
407-823-5529

Stephen B. Rodi
Dean- Mathematics and Science
Austin Community College
5930 Middle Fiskville Rd.
Austin, TX 78752
512-223-3300

Ronald C. Rosier
Conference Board of the
Mathematical Sciences
1529 Eighteenth St NW
Washington, DC 20036
202-293-1170

Richard Rutkowski
President
Green River Community College
12401 SE 320th Street
Auburn, WA 98092
253-288-3340

*** Karen Sharp**
Department of Mathematics
Charles S. Mott Community
College
1401 E. Court Street
Flint, MI 48503
810-232-3980

Larry Smyrski
Department of Mathematics
Henry Ford
Community College
5101 Evergreen Road
Dearborn, MI 48128-1495
313-845-6388

Lynn A. Steen
Department of Mathematics
St. Olaf College
1520 St. Olaf Avenue
Northfield, MN 55057
507-646-3412

James H. Stith
American Institute of Physics
Department of Physics
Ohio State University
174 W. 18th Street
Columbus, OH 43235
614-292-7436

Linda Swartz
Teacher- Mills E. Godwin High School
2101 Pump Road
Richmond, VA 23233
804-750-2600

Carla Thompson
Department of Mathematics
Tulsa Community College
3727 East Apache
Tulsa, OK 74115
918-595-7505

Michael Tinnesand
Department Head for K-12 Science
American Chemical Society
1155 16th Street NW
Washington, DC 20036
202-872-4382

Carlene Tonini
MASTEP Campus Coordinator
Department of Biology
College of San Mateo
1700 West Hillsdale
San Mateo, CA 94402
650-574-6250

Patricia Traynor
Dean- Technologies, Mathematics and Sciences
William Rainey Harper College
1200 W. Algonquin Road
Palatine, IL 60067
847-925-6793

Gwen Turbeville
Department of Mathematics
J. Sargeant Reynolds Community College
P.O. Box 85622
Richmond, VA 23285-5622
804-786-6770

Dean VanTrease
President
Tulsa Community College
6111 E. Skelly Dr. #202
Tulsa, OK 74135-6198
918-595-7868

 # Andrea Vargas
Phi Theta Kappa
Scottsdale Community College
9000 East Chaparral Road
Scottsdale, AZ 85250-2699
602 423-6000

Nancy Vrooman
Department of Mathematics
William Rainey Harper College
1200 West Algonquin Rd
Palatine, IL 60067
847-301-7808

 # Regena C. Wake
Phi Theta Kappa
Mineral Area College
P.O. Box 1000
Park Hills, MO 63601
573-431-4593

 # Angela B. Walters
Phi Theta Kappa
University of Alabama at Birmingham
Birmingham, AL 35294-0104
(205) 934-4011

Vivian Lee Ward
President -National Association of Biology Teachers
Access Excellence@Genentech, Inc.
MailStop #16B
1 DNA Way
San Francisco, CA 94080
650-225-8750

Ronald Williams
Acting President
Community College of Philadelphia
1700 Spring Garden Street
Philadelphia, PA 19130-3991
215-751-8350

Anna Wilson
President - Association of Biology Laboratory Educators
Purdue University
1153 Biochemistry Bldg.
West Lafayette, IN 47907
765-494-1644

++ Susan S. Wood
Department of Mathematics
J. Sargeant Reynolds Community College PRC
Engineering and Applied Science
P.O. Box 85622
Richmond, VA 23285-5622
804-371-3027

*** Jacqueline Woods**
Liaison for Community Colleges
Office of Vocational and Adult Education
U.S. Department of Education
600 Independence Ave SW
MES Building, Rm 4076
Washington, DC 20202
202-205-5451

*** Vera Zdravkovich**
President for Instruction
Prince Georges Community College
301 Largo Road
Largo, MD 20744-2199
301-322-0406

Deborah Zopf
Coordinator of Pre-Education Programs
Instructor of Mathematics
Henry Ford Community College
5101 Evergreen Road
Dearborn, MI 48128-1495
313-845-6430

Conference Leadership

** Steering Committee Chair
* Steering Committee Member
++ Coordinating Committee Co-Chair
\+ Coordinating Committee Member
\# Student Participant

Participants from the National Science Foundation 4201 Wilson Boulevard Arlington, Virginia 22230

Office of the Director

Neal Lane, Director

Division of Undergraduate Education

Room 835
703-306-1666

Myles Boylan
Norman Fortenberry, Division Director
Jack Hehn
Joan Prival
Elizabeth Teles
Robert Watson, Division Director (on assignment)
Margaret (Peggie) Weeks
Terry Woodin

Division of Elementary, Secondary, and Informal Education

Room 885
703-306-1620

John (Spud) Bradley
Joyce Evans
Tonia Thompson

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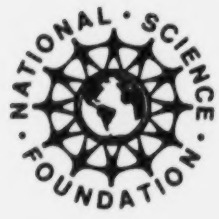

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